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The Shape of Cod on the Flemish Cap

by

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INTRODUCTION

One of the hypotheses explaining variation in year-class size of cod is that the physical condition of the parent stock influences the viability of eggs and subsequent survival of young. During a survey of the Flemish Cap in January-February 1982, a number of measurements were made on fresh specimens which were then frozen. Further observations were subsequently made in the laboratory.

MATERIALS AND METHODS

Cod were selected such that several specimens were taken at each 3 cm group. The sample is therefore not random with respect to length.

Measurements at Sea (see Table 1)

Fresh specimens were measured as follows: (See also Fig. 1).

FL	Fork length - snout to mid-point of caudal fin.
SL	Standard length - snout to end of vertebral column.
TL	Total length-snout to greatest extent of lobes of caudal fin compressed to the mid line.
H	Head length - snout to operculum.
S	Snout length - Snout to posterior of orbit.
O	Orbit length - Diameter of orbit along horizontal plane.
P	Postorbital length - posterior edge of orbit to operculum.
IO	Interorbital width.
D_1	Snout to anterior of first dorsal
D_2	Snout to anterior of second dorsal
D_3	Snout to anterior of third dorsal
P_1	Snout to anterior of pelvic
P_2	Snout to anterior of pectoral
A_1	Snout to anterior of first end
A_2	Snout to anterior of second end
V	Snout to anterior of vent
LP	Base of pelvic to longest ray
LPR	Extension of second pelvic ray
BD	Body depth at beginning of first dorsal
PD	Minimum caudal peduncle depth
G	Girth at beginning of first dorsal
M	Maximum vertical opening of mouth

Counts at the laboratory (see Table 2)

A	Age in years derived from otoliths
D_1	Number of rays in the first dorsal
D_2	Number of rays in the second dorsal
D_3	Number of rays in the third dorsal
A_1	Number of rays in the first anal
A_2	Number of rays in the second anal
P_1	Number of rays in the left pelvic
P_2	Number of rays in the left pectoral
DC	Number of rays in the dorsal portion of caudal
H	Number of rays in the hypural
VC	Number of rays in the ventral portion of caudal
V	Number of vertebrae including hypural

Other observations (see Table 3)

S	Sex
M	Maturity
L	Number of Lernaeocera
RW	Whole weight
GW	Gutted weight including gills
G	Gonad weight
LW	Liver weight
SW	Stomach weight including contents
R	Weight of remainder of guts
RV	Volume of the whole fish
GV	Volume of the gutted fish including gills

RESULTS

Only a very preliminary analysis has been made to date. Body measurements appear to vary in a regular and predictable way but not necessarily in direct proportion to length.

Sufficient data are presented for the calculation of condition factors, although these calculations have not been made.

Vertebrae and fin ray counts, as expected, showed no trend with length. The number of pelvic fin rays was always 6 although 1 specimen, apparently damaged, appeared to have only 5.

No Lernaeocera were found.

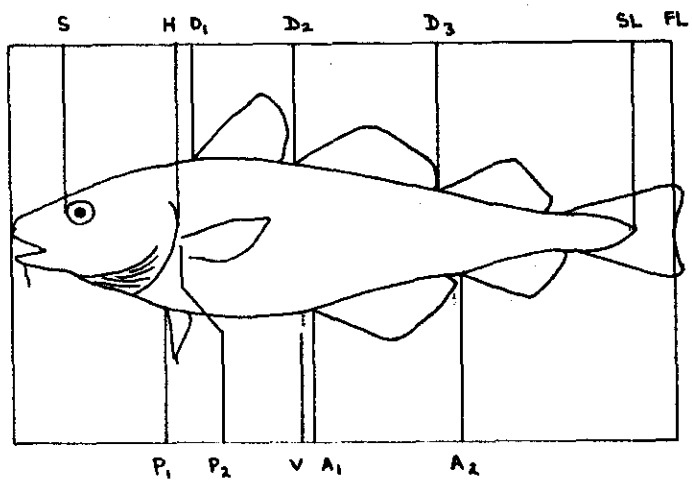

Fig. 1. The posterior ends of measurements made from the tip of the snout. Letter codes are explained in the text.

Table 1. Morphological measurements on a sample of cod from the Flemish Cap.

#	FL	SL	TL	H	S	O	P	10	D_1	D_2	D_3	P_1	P_2	A_1	A_2	V	LP	LPR	BD	PD	G	M
418	108	100	110	259	84	67	105	50	305	433	681	263	240	446	693	432	146	45	190	37	47	113
358	120	110	121	295	99	90	117	60	352	507	777	321	297	552	813	531	154	40	214	39	59	147
421	213	198	216	500	173	129	210	98	604	879	1365	523	479	958	1375	940	287	83	348	82	87	222
348	241	223	245	590	180	152	250	103	700	1010	1600	610	540	1060	1640	1020	316	93	448	86	114	230
399	255	236	258	590	195	135	255	110	720	1070	1690	620	530	1110	1700	1030	337	88	422	101	104	248
398	272	251	274	600	241	135	291	144	740	1100	1770	610	510	1150	1800	1090	337	86	529	95	129	252
347	282	260	285	670	210	121	320	131	790	1200	1820	690	590	1250	1910	1210	383	104	569	123	139	313
345	314	291	316	710	200	149	380	143	870	1340	2050	740	630	1390	2060	1340	385	110	626	135	158	350
304	324	301	326	700	210	135	371	180	900	1380	2050	780	650	1360	2120	1300	378	101	643	144	156	298
346	327	304	330	750	240	133	390	159	910	1340	2100	760	650	1410	2130	1340	429	144	668	128	155	327
331	339	312	343	760	240	138	400	198	920	1450	2210	810	630	1450	2260	1360	425	170	641	136	162	312
420	366	339	368	860	290	166	420	175	990	1480	2370	870	760	1620	2450	1540	426	129	672	150	174	410
425	370	345	372	850	250	171	440	187	1020	1590	2410	870	710	1580	2460	1510	484	146	686	151	175	360
427	403	374	407	930	280	191	490	237	1140	1710	2630	940	790	1710	2700	1630	485	141	802	171	204	380
397	408	378	413	970	300	191	490	211	1110	1730	2620	970	810	1770	2680	1700	538	170	782	171	191	440
402	426	392	434	1020	280	230	520	195	1200	1810	2750	1030	860	1840	2830	1770	575	161	718	171	193	453
342	427	396	433	1050	320	181	550	204	1190	1800	2780	1060	920	1920	2860	1850	574	195	819	164	206	433
333	456	424	463	1080	300	245	550	282	1260	1940	3020	1120	950	2060	3110	1960	521	173	845	194	214	471
305	469	435	473	1070	360	237	500	223	1270	1970	3040	1150	990	2080	3110	1990	571	109	949	207	225	435
340	481	445	485	1110	300	211	620	269	1340	2060	3140	1130	920	2110	3220	1990	582	155	978	208	239	486
336	486	452	492	1150	340	238	590	268	1350	2260	3170	1170	960	2150	3260	2040	556	153	925	209	242	522
335	518	484	525	1210	370	214	640	294	1510	2240	3420	1280	1120	2420	3530	2300	606	214	1093	211	277	549
334	531	490	537	1230	370	228	660	306	1510	2340	3540	1320	1110	2250	3590	2280	666	226	1107	232	278	522
343	541	501	547	1340	430	236	680	304	1540	2350	3600	1370	1250	2440	3660	2350	679	198	1052	231	272	532
325	547	506	556	1390	470	238	710	311	1620	2290	3630	1380	1100	2510	3680	2380	655	192	1210	251	296	624
332	566	523	570	1320	410	246	680	349	1570	2430	3740	1380	1230	2610	3800	2400	623	182	1135	233	272	550
341	588	551	593	1360	390	256	740	326	1600	2570	3940	1400	1160	2690	4020	2570	652	192	1245	254	299	593
302	603	558	614	1410	470	250	705	342	1670	2580	4020	1500	1230	2660	4240	2520	691	239	1230	270	290	663
356	618	574	628	1550	470	282	800	381	1700	2610	4100	1530	1300	2820	4260	2710	682	219	1289	298	311	605
306	639	592	644	1560	460	276	780	355	1820	2770	4350	1560	1280	2940	4420	2810	704	226	1374	303	325	630
307	644	604	657	1410	440	270	760	396	1760	2800	4340	1420	1260	2870	4400	2690	699	194	1379	279	373	611
344	660	616	671	1600	480	267	870	395	1930	2940	4550	1600	1280	3100	4560	2960	804	215	1393	268	344	641
357	679	627	688	1580	510	263	870	394	1860	2870	4480	1630	1350	3020	4570	2860	775	233	1467	289	359	653
326	694	643	704	1630	510	258	895	416	1940	2970	4590	1700	1480	3160	4680	3000	800	198	1384	275	338	659
404	704	657	715	1640	470	331	900	376	1980	3100	4790	1620	1550	3360	4830	3150	771	241	1465	282	403	750
396	717	667	726	1720	500	318	940	409	2050	3220	4870	1770	1490	3420	4930	3300	774	210	1843	316	446	840
417	727	679	749	1770	520	325	950	416	2120	3210	4920	1820	1600	3450	5000	3230	700	220	1536	305	381	760
386	748	697	753	1830	580	303	960	424	2190	3260	5130	1860	1560	3490	5160	3320	860	286	1545	294	376	820
403	753	700	763	1900	560	311	1070	464	2240	3450	5090	1950	1700	3570	5180	3450	806	269	1578	314	404	890
354	788	737	802	1940	590	299	1070	466	2300	3540	5220	2000	1700	3860	5360	3690	841	261	1879	348	476	812
366	802	753	821	2040	660	307	1120	470	2320	3630	5520	2120	1800	3840	5580	3690	832	289	1594	334	402	830
368	808	752	819	1900	590	339	1020	465	2340	3580	5410	1960	1610	3660	5550	3520	906	361	1642	345	400	860
392	808	754	821	1990	590	335	1070	500	2310	3590	5530	1970	1770	4090	5700	3880	848	266	1910	331	514	890
400	812	760	821	1860	530	334	1010	429	2200	3520	5290	1930	1610	3720	5450	3530	834	251	1672	320	420	870
303	841	783	852	2120	700	345	1170	532	2440	3830	5800	2160	1760	4110	5900	3890	963	251	1930	367	482	952
330	855	800	871	2040	620	335	1120	489	2490	3830	5900	2120	1850	4170	5970	3940	906	292	1799	357	456	852
394	870	818	882	2070	650	336	1120	481	2400	3870	5830	2100	1840	4110	5970	3940	895	255	1823	360	464	890
390	871	807	884	2060	660	338	1110	474	2550	3880	5900	2070	1670	4090	6020	3860	1038	296	1891	368	479	920
423	906	847	916	2220	660	317	1250	574	2630	4170	6160	2160	1760	4370	6290	4180	1023	252	2157	360	567	980
411	918	856	929	2260	660	354	1240	562	2630	4120	6250	2260	1950	4470	6360	4340	972	361	2049	371	544	1050
393	928	867	941	2220	710	359	1180	586	2710	4220	6410	2300	1960	4640	6460	4430	988	309	2043	414	503	990
391	953	890	959	2380	730	365	1330	507	2740	4340	6480	2370	1900	4740	6630	4440	1037	305	2072	402	541	1030
385	964	903	980	2360	730	325	1340	574	2840	4390	6600	2410	2040	4830	6780	4580	995	292	2267	388	569	1040
387	976	905	989	2440	720	380	1400	578	2890	4420	6780	2440	2020	4680	6760	4460	1062	324	2190	399	564	1160
362	1005	942	1023	2470	760	358	1430	601	3030	4660	7020	2570	2100	5020	7110	4760	1008	294	2397	419	620	1010
363	1011	944	1018	2520	820	386	1350	607	3010	4590	6870	2530	2080	5140	7080	4880	1059	324	2464	400	617	1050
416	1015	951	1030	2480	820	351	1360	651	3070	4610	6900	2520	2050	4970	7150	4700	1089	335	2481	442	631	1140
426	1027	958	1036	2400	760	356	1270	605	2890	4720	6980	2390	1900	5110	7130	4820	1134	401	2586	423	637	1110
359	1060	987	1068	2650	820	361	1510	636	3150	4700	7410	2740	2280	5070	7380	4880	1069	274	2286	413	575	1180
389	1068	994	1078	2660	880	383	1430	664	3170	4910	7360	2650	2370	5400	7480	5190	1031	266	2526	426	660	1280
424	1081	1016	1094	2740	830	406	1540	735	3320	4930	7500	2720	2300	5560	7770	5250	1089	316	2720	473	676	1160
360	1097	1018	1113	2770	920	366	1490	743	3290	4860	7300	2790	2420	5370	7430	5110	1273	355	2584	446	620	1160
361	1113	1031	1126	2910	910	429	1570	719	3430	5140	7710	2800	2330	5550	7760	5270	1168	298	2910	485	720	1110
355	1158	1076	1174	3060	930	453	1690	832	3520	5220	7890	3050	2570	5740	8140	5540	1246	379	2469	514	656	1180

Table 2. Meristic observations on a sample of cod from the Flemish Cap.

#	AGE	D_1	D_2	D_3	A_1	A_2	P_2	P_1	DC	H	VC	V
418	1											
358	1											
348	2	16	21				20	6				55
347	2	15	22	19		19	21	6	26	4	27	
346	2	14	22	21	22			6				54
345	2	16	21	21		20	21	6		4	26	54
331	2	15	19	21	23	20	22	6	24	5	25	54
420	2	16	23	21		21		6		4		56
425	2	15	21	21	25	22	21	6	25	4	27	55
421	2						20		25	4	26	
399	2					20	20		24	4	26	54
398	2	15				21	20	6		4	26	55
304	2	15	19	22	25		21	6	25	4	26	54
397	3	15	19	23	22	21	20	6	25	4	26	54
427	3	15	22	19	25	19	21	6	24	4		54
402	4			20		20	20	6	26	4	27	56
335	4	14	20	19	24	20	21	6				55
333	4		23	20	24	20	20	6	25	4	26	54
343	4	16	21	20	25		20	6	25	3	25	54
342	4	15	23	23	25	22	22	6		4	26	55
340	4	15	20	22	24	21	20	6	25	4	26	55
336	4		20	20	22		20	6	25	4	26	54
305	4	15	21	21		20	20	6				57
307	5	15	20	20	24	21	21	6	25	4	26	56
306	5	15	21		24	18	21	6	24	4	24	55
302	5	14	21	20	24	20	20	6		4	26	55
341	5	16	19	20	22			6	25	4	26	56
344	5	16	21	23	24		21	6	25	4	27	55
332	5	16	23	22	25	22	21	6	26	3	27	55
334	5	15	21		25		20	6	25	4	26	54
326	5	15	22	22	25	22	22	6	25	4	26	55
325	5	14	21	19	25	19	20	6	25	4	26	
357	5	15	19	21	26	22	20	6				54
356	5			20	25	21	20	6	26	4		54
354	7	15	20	23	21	22	20	6		4		54
368	7	16	20	20	23	20	21	6	25	4	26	55
404	7	16	20	19		20	20	6	27	4	26	54
400	7	16	20	23	23	22	21	6	26	4	26	56
417	7	15	21	21	22	20	20	6	25	3	25	55
416	8	16	22	20	26	21		6	26	4	28	56
411	8	16	21	22	24	20	21	6	25	4	26	55
403	8	14	19	20		20	20	6	26	4	27	56
394	8	17	22	23		22	20	6	25	3	26	55
366	8	15	21	23	25	21	20	6	24	3	25	55
386	9	16		21			22	6	25	4	26	55
385	9	17	23	22	25	22	20	6	25	4	26	54
363	9	15	22	23		22	20	6	25	4	26	55
362	9	15	22	21	25		21	6	24	4	24	55
360	9	16	21	22	22	20	20	6	25	4	26	55
359	9	14	23	20	25	20	20	6	24	4	25	55
330	9	16	22	19		19	20	6	26	4	27	55
396	9	16	23	20	28	20	20	6		4	26	55
393	9	17	23	21	28	21	20	6	25	4	26	55
392	9	15	20	21		20	20	6	25	3		55
391	9	17	21	21	28	22	19	6	25	4	25	55
390	9	16	21	19	23	21	20	6		4	27	57
389	9	16	22	21	25	21	20	6		4	26	54
387	9	15	22	19	25	18	21	6	25	4	26	55
423	9	17	22	22		20	23	6	26	4	27	55
424	9	14	22	19	24		20	6		4	28	56
426	9	17	19	21	23	20	20	6	25	4	26	54
303	9	16	22	21	25	22	20	6	26	4	27	54
361	11	15	21	20			22	6	26	4	27	54
355	16		20	21	25	21	20	6			25	55

Table 3. Sex, maturity and parasites, and weight measurements for for a sample of cod from the Flemish Cap.

#	FL	S	M	RW	GW	G	LW	SW	R	RV	GV
418	11	5	500	.01	.01					9	7
358	12			.	.01						8
421	21	1	100	.08	.07	1	1	2	2	74	65
348	24	5	500	.12	.10	1	1	6	5	115	94
399	26	5	500	.13	.11	1	1	2	5	122	106
398	27	1	100	.16	.13	1	2	16	6	157	130
347	28	1	100	.21	.17	1	3	21	7	209	168
345	31	5	500	.28	.22	1	3	28	10	271	213
304	32	5	500	.30	.26	1	9	7	10	283	251
346	33	1	100	.32	.25	1	7	28	12	303	243
331	34	5	500	.35	.30	1	13	6	13	336	287
425	37	5	500	.46	.40	1	14	17	15	440	365
420	37	1	100	.43	.38	1	6	14	8	410	357
427	40	5	500	.62	.55	2	12	13	23	623	515
397	41	1	100	.60	.51	1	16	24	22	570	489
402	43	5	500	.65	.57	4	8	14	30	618	545
342	43	1	142	.71	.59	41	17	17	18	690	560
333	46	5	500	.84	.76	3	23	16	23	816	717
305	47	1	142	.88	.72	56	18	12	25	850	698
340	48	5	500	1.13	.95	5	61	56	40	1090	905
336	49	1	100	1.06	.93	1	43	26	43	1010	890
335	52	5	500	1.39	1.15	3	46	83	47	1335	1095
334	53	5	520	1.48	1.22	90	66	25	48	1426	1170
343	54	5	500	1.49	1.31	7	62	31	50	1420	1250
325	55	5	520	1.77	1.39	147	110	62	58	1700	1310
332	57	5	500	1.67	1.44	7	113	39	44	1610	1365
341	59	1	142	2.00	1.61	170	95	35	70	1948	1520
302	60	1	142	1.99	1.60	172	39	29	55	1928	1530
356	62	5	500	2.28	1.97	11	50	80	47	2475	1970
307	64	1	142	2.59	2.22	122	63	32	69	2890	2105
306	64	1	142	2.66	2.13	220	70	57	84	2640	2025
344	66	1	142	2.82	2.27	192	116	54	103	2790	2240
357	68	1	142	3.06	2.45	282	55	63	83	2610	1785
326	69	5	520	2.93	2.37	154	176	57	115	2810	2260
404	70	1	142	3.53	2.59	398	195	45	103	3475	2185
396	72	5	520	4.71	3.63	444	200	147	176	4490	3260
417	73	5	520	3.73	2.83	482	176	58	77	3660	2650
403	75	5	520	4.53	3.66	283	215	154	162	4352	3380
386	75	1	142	4.17	3.41	346	128	62	129	4160	3345
354	79	5	520	5.55	4.24	383	527	96	197	5120	3780
366	80	5	520	4.94	4.00	380	240	87	180	4756	3670
368	81	1	254	4.74	4.04	10	250	122	212	4545	3950
400	81	5	520	5.29	4.07	358	327	214	232	5030	3920
392	81	5	520	6.23	4.34	942	569	104	224	6110	4050
303	84	1	142	6.52	5.19	737	166	80	160	6270	5090
330	86	1	142	6.26	4.89	670	232	227	230	5870	4560
394	87	5	520	6.30	4.94	662	290	184	258	6010	4800
390	87	5	520	6.78	5.31	484	408	296	194	6665	5179
423	91	5	520	8.74	6.43	646	655	439	341	8400	5948
411	92	1	142	8.34	6.53	857	255	131	173	8292	6220
393	93	5	520	8.59	6.55	940	568	213	220	8260	6210
391	95	5	520	9.67	7.60	695	546	272	372	9200	7075
385	96	5	520	10.47	7.69	1323	735	257	324	10200	7390
387	98	5	520	10.27	7.97	900	703	300	298	9840	7430
363	101	5	520	12.43	8.54	1074	700	1582	316	11990	8280
362	101	5	520	12.57	10.02	842	919	392	275	12100	9690
416	102	1	142	12.77	9.56	1585	721	604	227	12085	8798
426	103	1	142	13.25	9.82	1677	420	247	368	12745	8955
359	106	1	142	11.32	8.99	1300	474	293	240	10850	8500
389	107	5	520	13.95	10.33	2004	377	267	386	13675	10200
424	108	5	520	16.91	12.94	1810	1250	416	314	15790	11990
360	110	5	520	14.16	11.24	1203	771	362	498	13375	11010
361	111	5	520	18.16	13.48	2040	1262	524	614	17320	12580
355	116	1	142	15.89	12.88	1471	487	417	359	15270	11810